A VERY GRAVE PROBLEM.

IS THE WATER OF NEWARK AND JERSEY CITY FIT TO DRINK?

The Water Intake for the Two Cities is at Belleville on the Passaic—Above Belleville the River Receives the Sewage and the Factory Waste of Paterson and Passaic, and Below Belleville the Waste and Sewage of Newark—At Times the Tide Sets Back so that Newark Waste is Carried Above the Intake—The Watch that is Kept Upon the River—An Analysis of the Water—The Syndicate that Stands in the Way of an Absolutely Pure Supply.

I.

Given a manufacturing city of 160,000 people, situated on a pretty river near where it empties into the sea; given the fact that the city takes its supply of water from the river about eight miles from its mouth and less than two miles above the city limits; given also the fact that the sewage of the city pours into the river, and that the tide sometimes carries refuse nearly a mile above the point where the city takes its water; and given further that only eight miles up the stream is another growing manufacturing city emptying its refuse, that another eight miles up is still another city of factories and of 70,000 people using the river for a sewer, that between this latter city and the point where the city of 160,000 people takes its water at least one tributary, the banks of which are dotted with paper, print and chemical works, empties into the river—given all this, the problem is to find whether the water drawn from a faucet in that city of 160,000 people is good or bad, whether it is conducive to the health and the material growth of that city, or otherwise, and if, otherwise, to find what is to be done when that city has out already $3,485,000 of water bonds, and when, to build new works, as many more will have to be issued.

Here is a rectangular quadrilateral bit of earth eighteen miles long and seven miles wide reduced to fourteen ems measure to accompany the above problem. A half a dozen railroads, three of them great trunk lines, run out over it in various directions. The pretty river, the Passaic, flows through the centre into the Newark Bay, and a small part of the Hackensack comes within the limits. On this bit of earth so admirably situated for manufacture and commerce are three cities—Newark, the city of 160,000 people; Paterson with about 70,000, and Passaic with about 12,000. A little of Jersey City appears on the map, but leaving that city out of consideration for the present, there are clustered together and scattered about over this small area 250,000 people, and, with the facilities for trade, it will require only a few years for this population to be doubled. What will this great population in the future do for its water supply?

On this problem and its variations the people of Newark have been figuring for a whole decade. A great many issues have grown into it, and so many different interests have had an influence upon it that, instead of a question of two sides, it has become so complicated as to be almost unmanageable. Jersey City, with a water debt of over $4,000,000, has been working on the problem too, with almost as much zeal and with probably more reason, for the Jersey City supply is taken from the Passaic River, as will be seen from the map, about a mile below the point where Newark's is taken, and is apparently more liable to be polluted by the impurities carried up by the tide from Newark, if the tide really does habitually carry up dangerous impurities. But this is one of the disputed points. That portion of the river which has been beyond question contaminated by the sewage of Newark at times is the black portion indicated on the map.

II.

A BIT OF HISTORY.

The present water works of Newark were built in 1869-70, the city then having outgrown the capacity of a small system of supply from springs, which had been in operation for about sixty years, under the control of a private company up to 1860, when an act was passed authorizing the Mayor and Common Council to purchase the property and create the Aqueduct Board. The population of Newark was then about 72,000. In 1870, when the present works were completed, the population had increased to 105,000. The beautiful Passaic, with its headwaters among the numerous small lakes scattered through northern New Jersey, seemed the natural supply for the growing city at its mouth. The river was then comparatively free from pollution, and it was decided to take the water from Belleville. But the mistake was soon learned, and shortly after the works were completed the question of whether the water was good or bad began to agitate the people. Paterson and Passaic had taken a long leap forward. Manufactories had sprung up along the banks of the river and its tributaries, and, although the banks about Belleville were as pretty as ever, it began to be suspected that the river was at times in a filthy condition.

The Jersey City works had been in operation longer than those of Newark, and the fact that the river was impure caused a commotion as early as 1872. In an official report made to the Jersey City Board of Public Works in that year the people were informed that the water "was highly offensive both to smell and taste, was turbid from the presence of great numbers of microscopic vegetable and animal organisms, and revealed a shocking degree of contamination by organic matter." The next year a commission was appointed to ascertain the best means of supplying the city of Hoboken with water from another source. It found the water in the Hackensack, a low meadow river, superior to that of the Passaic. Feeling became so strong in Newark that in 1878 the Aqueduct Board appointed a commission of experts to make surveys and report the most favorable plans for getting a new supply. The experts were J. J. R Croes and George W. Howell. In their report made in 1879 they enumerate the sources of pollution, tracing them down from Paterson and giving even lists of chemicals thrown into the water from various mills. Coming down to Belleville they say:

> At the pump works at Belleville the water was very dark and turbid. The tide ebbs and flows here. A float, consisting of a tin tube four feet long loaded so as to stand vertically in the water, was placed in the centre of the channel at the Morris and Essex Railroad bridge at Division street (Newark) just at the turn of the tide. It was carried by the flood tide in 5½ hours to a distance of 1,700 feet above the pump works.

The inference from this was plain. If the tide carried a float above the Newark intake, it would undoubtedly carry up the sewage of Newark the same distance. But further on in their report, under the head of the examination of projects for a new supply, they say:

> If a plentiful supply of good water can be obtained at a moderate cost at the present location of the pump works any plan involving their retention is to be preferred. As at present situated, it has been shown that the water taken there is exposed to contamination from the back flow of the Newark sewage, the drainage of the Third River valley, the sewage of Passaic and Paterson, and the contamination from a number of factories. When the tide is flowing, all these sources of impurities have their greatest effect, and the water is decidedly objectionable even now. With the increase of population in Newark and along the river it must become more impure.

This exhaustive report, embodying, besides the practical condemnation of the present supply, the results of their thorough investigation of the advantages offered by the numerous fountain heads in the upper division of the Passaic Basin, was widely circulated and read, but the only people it seemed to stir up was a syndicate of New York capitalists, who proceeded to get both bowers and the joker into their hands by getting control of all the ponds in northern New Jersey recommended by Croes and Howell as the most available sources for supply. The only lakes which have escaped, it is said, are Greenwood and Hopatcong. The syndicate confidently sat down in an office in Broadway to wait for both Newark and Jersey City, also for anybody else in that vicinity who might want water, to get ready to pay a fixed and quite large price per million gallons for water delivered into their reservoirs. The syndicate is still, in all confidence, sitting and waiting, and is likely to do so for some time. All attempts on the part of the Aqueduct Board and such citizens as were anxious for a new supply were balked by various kinds of opposition, so that Newark went on pumping its water from Belleville.

The Board then did what it could to make the water as good as possible. An act passed in the Jersey Legislature, approved in 1880, made it a misdemeanor to throw into the Passaic any offensive matter, punishable by a fine not exceeding $10, or by imprisonment not exceeding two years, or both. But all the factories along the Passaic and its tributaries poured out their filth just the same. Circulars were sent to the proprietors, but with little effect. In the early part of 1880 everybody in Newark began to taste very perceptibly carbolic acid in the water. It was traced to Kingsland's Paper Mills, near the mouth of Third River, and J. & R. Kingsland were indicted. The Passaic was referred to in the indictment as "an ancient stream of pure water," which was supposed to mean that the water was pure in the long ago. The mill owners made the unique defence that, even if they did cause carbolic acid to be turned into the Passaic, the water of the Passaic was so foully polluted by other persons that what they themselves did made no appreciable addition to the pollution already there, and, furthermore, it really acted as a disinfectant, purified the water, and rendered it more fit for drinking purposes. The verdict sustained the right of the people to receive the water unpolluted. Unquestionably under the law they did have the right, but did they receive the water unpolluted, or could they?

"We have settled on this river for manufacturing purposes," said the factory owners; "if you deprive us of the privilege of emptying our refuse, we must take our industries elsewhere. Besides, how do you know we pollute the water? You drink it, and apparently are not hurt. Why don't you proceed against the thousands of owners of houses along the banks with pipes from the closets emptying into the stream? Why don't you go and indict yourself for polluting the stream with your own sewage?"

This reasoning was unmistakably sound, and tended to further complicate the growing problem. A strenuous effort was made in 1882 to secure the passage of a bill authorizing the damming up of the Passaic to keep back the tide and Newark sewage, but, like other attempts at improvement, it failed.

This conditon of things led to the appointment of a useful institution called the Joint Board on Pollution of Water Supply of Jersey City and Newark, composed of three members of the Newark Aqueduct Board, two of the Jersey City Board of Public Works, and one from the Jersey City Board of Finance. This Board went to work to do what it could to make the river pure in face of the population growing up on either bank, and it has, so far as it could, succeeded. The Board has employed a chemist to make monthly analyses of the water taken from different localities, and an inspector who now has a steam launch in which he patrols the river every day to look out for fresh pollutions.

And so things have gone until now.

III.

A LOOK AT THE PASSAIC AS IT IS.

The present inspector of the pollution of the Passaic is Thomas W. Leake of Jersey City, and he kindly gave the reporter of THE SUN an opportunity to accompany him on two of his trips. His launch is a black-hulled little water skipper, which, by reason of the peculiar duty it has been enlisted to perform, has become an object of terror along the lower banks of the Passaic, where some of the polluting industries are stationed. The launch starts every day from the foot of Fourth avenue, Newark. Mr. Leake handles the rudder and Engineer "Charley" keeps down the steam of the ambitious boat. Charley's father used to catch shad in the Passaic, 800 at a haul sometimes, so he says; but that was over thirty years ago, before the river began to be much of a sewer, and before Newark began drinking out of it.

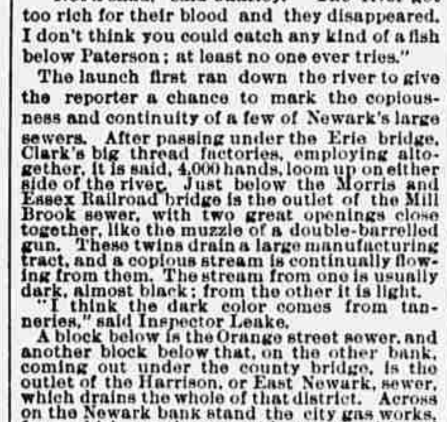
"Any shad in the river now?" we asked.

"Not a shad," said Charley. "The river got too rich for their blood and they disappeared. I don't think you could catch any kind of a fish below Paterson; at least no one ever tries."

The launch first ran down the river to give the reporter a chance to mark the copiousness and continuity of a few of Newark's large sewers. After passing under the Erie bridge, Clark's big thread factories, employing altogether, it is said, 4,000 hands, loom up on either side of the river. Just below the Morris and Essex Railroad bridge is the outlet of the Mill Brook sewer, with two great openings close together, like the muzzle of a double-barrelled gun. These twins drain a large manufacturing tract, and a copious stream is continually flowing from them. The stream from one is usually dark, almost black; from the other it is light.

"I think the dark color comes from tanneries," said Inspector Leake.

A block below is the Orange street sewer, and another block below that, on the other bank, coming out under the county bridge, is the outlet of the Harrison, or East Newark, sewer, which drains the whole of that district. Across on the Newark bank stand the city gas works, from which are thrown out large quantities of coal tar, blackening the river and dressing all the spiles in mourning. For some distance below them the bank is occupied by Ballantine's large ale breweries. They have a drain of their own that rises almost to the dignity of a sewer, and from other outlets flows more refuse. From one of these was pouring a steaming torrent of white stuff, which floated off on the black water of the river in great streaks, dotted here and there by an uncollapsed bundle of froth. Close by is the mouth of the Rector street sewer, the champion sewer of Newark, always emitting a large stream of dirty, black water.



RESIDENCE ON THE PASSAIC.

The river at this point and below is certainly picturesque—in a way. Over its placid surface shines shapeless blotches of oil and coal tar, throwing off all the different rainbow colors as they glide away on the ripples curled from the bow of the little launch. Mingled with them are streaks of refuse of various chromatic effects, while the water underneath looks as black as night. There is no bank to the river on the west side. The factories and warehouses tower straight up from the stream on spile foundations, and every water-soaked log shows, when the tide is out, how high the water goes by the greasy and streaked scum left on it.

"It is just about like this the rest of the way down," said the inspector, giving the rudder a flop and jumping the little launch around nose up stream.

Just above where the launch started is the Fourth avenue sewer, the highest one in Newark at present. Another is soon to be opened, however, about a quarter of a mile further up. A large new thread factory in Kearney, just opposite Fourth avenue, empties its refuse through a large drain pipe. A little way further on the Kearney side, and not a mile and a half from Belleville, where the intakes are, another large factory is being erected, and its owners have signified their intention of running a large drain into the river. They have been told that they cannot do so.

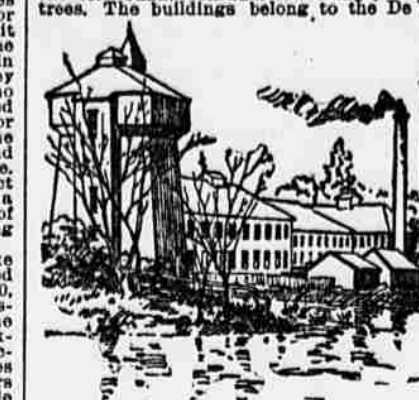
"But," said Inspector Leake, "in spite of the efforts of the Board of Pollution, I presume they will find a way to do it; it is a serious matter for a factory which has been built on the banks of a river to be deprived of the privilege of getting rid of its refuse by the river."

At the time of the first trip made by the reporter of THE SUN, it was nearly low tide, and the current of the Passaic was flowing rapidly down. The water, of course, is always better near the intakes at low tide. When dipped up in a glass from the side of the launch it sparkled in the sunlight as clear as crystal and when it settled showed very little suspended matter.

"That doesn't look bad," said the reporter.

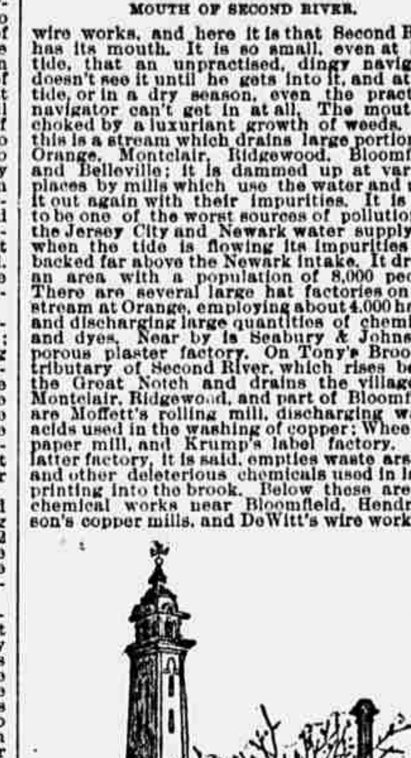
"No," said Mr. Leake, "that's what I can't make out, how this water shows up so good. And you will wonder when you get further up the river."

The banks of upper Kearney begin to rise higher and to take on some natural beauty before reaching the Belleville bridge. Through the trees come glimpses of fine residences a little back on the high ground, and for some distance on the other side of the stream stretches the Mount Pleasant Cemetery, so situated that its wash runs directly into the river. Just after the little launch has whisked under the New York and Greenwood Lake Railroad bridge a group of queer buildings appears on the left bank, behind a few hungry-looking trees. The buildings belong to the De Witt



MOUTH OF SECOND RIVER.

wire works, and here it is that Second River has its mouth. It is so small, even at high tide, that an unpractised, dingy navigator doesn't see it until he gets into it, and at low tide, or in a dry season, even the practised navigator can't get in at all. The mouth is choked by a luxuriant growth of weeds. Yet this is a stream which drains large portions of Orange, Montclair, Ridgewood, Bloomfield, and Belleville; it is dammed up at various places by mills which use the water and pour it out again with their impurities. It is said to be one of the worst sources of pollution of the Jersey City and Newark water supply, for when the tide is flowing its impurities are backed far above the Newark intake. It drains an area with a population of 8,000 people. There are several large hat factories on the stream at Orange, employing about 4,000 hands and discharging large quantities of chemicals and dyes. Near by is Seabury & Johnson's porous plaster factory. On Tony's Brook, a tributary of Second River, which rises below the Great Notch and drains the villages of Montclair, Ridgewood, and part of Bloomfield, are Moffett's rolling mill, discharging waste acids used in the washing of copper; Wheeler's paper mill, and Krump's label factory. The latter factory, it is said, empties waste arsenic and other deleterious chemicals used in label printing into the brook. Below these are the chemical works near Bloomfield, Hendrickson's copper mills, and DeWitt's wire works.



JERSEY CITY PUMPING STATION.

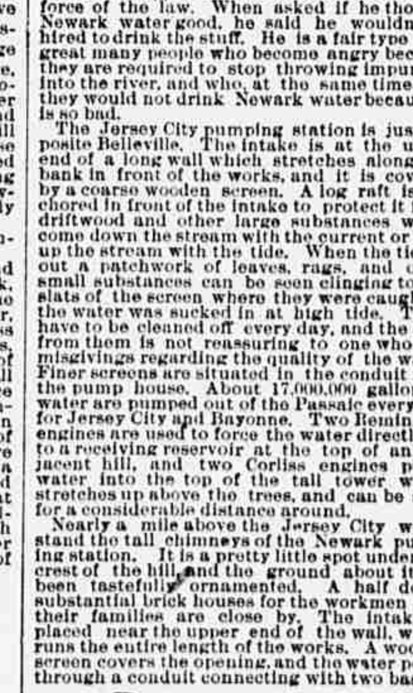
Above the mouth of Second River, the west bank of the Passaic is for a little ways skirted with the houses of Belleville. Formerly the drains from these houses led into the river, even opposite the Jersey City intake, but the Board of Pollution has caused all of them to be closed up and vaults to be built. This is true, also, at points all along the river. A prominent doctor in Belleville, who lives in a fine residence near the river, formerly ran a large drain from his house into the stream. He was told to close up the drain, and he got mad. He used the old argument.

"Why don't you folks go down and stop up your own drains at Newark?"

But he stopped the drain when he saw the force of the law. When asked if he thought Newark water good, he said he wouldn't be hired to drink the stuff. He is a fair type of a great many people who become angry because they are required to stop throwing impurities into the river, and who, at the same time, say they would not drink Newark water because it is so bad.

The Jersey City pumping station is just opposite Belleville. The intake is at the upper end of a long wall which stretches along the bank in front of the works, and it is covered by a coarse wooden screen. A log raft is anchored in front of the intake to protect it from driftwood and other large substances which come down the stream with the current or drift up the stream with the tide. When the tide is out a patchwork of leaves, rags, and other small substances can be seen clinging to the slats of the screen where they were caught as the water was sucked in at high tide. These have to be cleaned off every day, and the odor from them is not reassuring to one who has misgivings regarding the quality of the water. Finer screens are situated in the conduit near the pump house. About 17,000,000 gallons of water are pumped out of the Passaic every day for Jersey City and Bayonne. Two Remington engines are used to force the water directly up to a receiving reservoir at the top of an adjacent hill, and two Corliss engines pump water into the top of the tall tower which stretches up above the trees, and can be seen for a considerable distance around.

Nearly a mile above the Jersey City works stand the tall chimneys of the Newark pumping station. It is a pretty little spot under the crest of the hill, and the ground about it has been tastefully ornamented. A half dozen substantial brick houses for the workmen and their families are close by. The intake is placed near the upper end of the wall, which runs the entire length of the works. A wooden screen covers the opening, and the water pours through a conduit connecting with two basins,



NEWARK PUMPING STATION.

one on either side of the pump house, each 140 by 340 feet, and originally intended to act as filter and settling basins. At first considerable water collected in these basins, either as filtered river water or as spring water, but not enough to be considered a success, and so the river water was turned directly into them and the water pumped directly out of them by four Worthington engines, through two force mains, each of 30 inches diameter, to the Belleville reservoir, which is marked 1 in the map. This is 6,000 feet away, at an elevation of 167 feet above the river. The combined capacity of the pumps is 30,000,000 gallons every twenty-four hours. From the Belleville reservoir the water runs in a conduit 15,000 feet to the lower service distributing reservoir on Seventh avenue, Newark, marked 2. There another pump forces water up to the high surface reservoir, marked 3, on Orange avenue, a mile and a half away, and at an elevation of 225 feet. The cost of the construction of these works has been a little less than $4,000,000. The present cost of pumping a year's supply for Newark is about $52,000. About 15,000,000 gallons are pumped up from the Passaic at the Newark works every day.

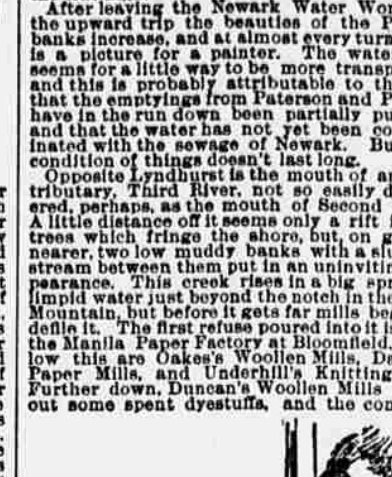
Mr. Burrett is the engineer in charge of the Newark works. When asked if he was much troubled by the suspended matters in the water choking the screens and getting into the boilers, he said that the screens became clogged very frequently, chiefly from leaves blown into

MOUTH OF THIRD RIVER.

the basins. The screens had to be lifted and cleared about twice a week. There was always considerable vegetable and decaying matter clinging to them, and the odor was not pleasant. The boilers are cleaned out once a month. Mr. Burrett showed a pile of dirt that had been raked out of one of the boilers, and there was enough to fill a bushel basket. Mr. Burrett said he never saw any traces of salt water in the boilers, even when the river was low and the tide high.

After leaving the Newark Water Works on the upward trip the beauties of the Passaic banks increase, and at almost every turn there is a picture for a painter. The water, too, seems for a little way to be more transparent, and this is probably attributable to the fact that the emptyings from Paterson and Passaic have in the run down been partially purified, and that the water has not yet been contaminated with the sewage of Newark. But this condition of things doesn't last long.

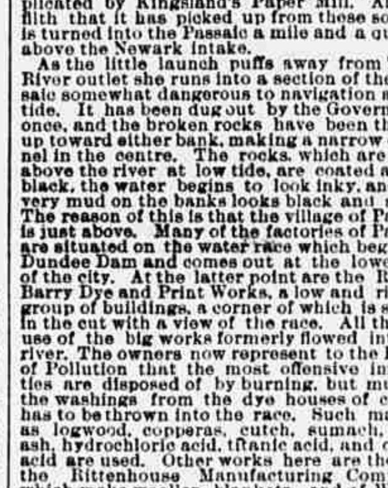
Opposite Lyndhurst is the mouth of another tributary, Third River, not so easily discovered, perhaps, as the mouth of Second River. A little distance off it seems only a rift in the trees which fringe the shore, but, on getting nearer, two low muddy banks with a sluggish stream between them put in an uninviting appearance. This creek rises in a big spring of limpid water just beyond the notch in the First Mountain, but before it gets far mills begin to defile it. The first refuse poured into it is from the Manila Paper Factory at Bloomfield. Below this are Oakes's Woollen Mills, Davies's Paper Mills, and Underhill's Knitting Mill. Further down, Duncan's Woollen Mills throw out some spent dyestuffs, and the constitu-



RACE, AND REID & BARRY'S FACTORY.

ency of the stream is further and finally complicated by Kingsland's Paper Mill. All the filth that it has picked up from these sources is turned into the Passaic a mile and a quarter above the Newark intake.

As the little launch puffs away from Third River outlet she runs into a section of the Passaic somewhat dangerous to navigation at low tide. It has been dug out by the Government once, and the broken rocks have been thrown up toward either bank, making a narrow channel in the centre. The rocks, which are lifted above the river at low tide, are coated a dull black, the water begins to look inky, and the very mud on the banks looks black and slimy. The reason of this is that the village of Passaic is just above. Many of the factories of Passaic are situated on the water race which begins at Dundee Dam and comes out at the lower end of the city. At the latter point are the Reid & Barry Dye and Print Works, a low and rickety group of buildings, a corner of which is shown in the cut with a view of the race. All the refuse of the big works formerly flowed into the river. The owners now represent to the Board of Pollution that the most offensive impurities are disposed of by burning, but much of the washings from the dye houses of course has to be thrown into the race. Such matters as logwood, copperas, cutch, sumach, soda ash, hydrochloric acid, titanic acid, and oxalic acid are used. Other works here are those of the Rittenhouse Manufacturing Company, which make woollen blankets, and of Waterhouse Brothers, manufacturers of cloth and flock, Watson's Bleachery, the Passaic City Gas Works, Jacob Basch & Sons' Woollen Cloth and Shoddy Mills, and the Passaic Print Works. As the launch passed the latter factory large streams of dark red water were pouring into the Passaic from twenty-inch pipes, one of which the artist caught for a picture. The water for



A REFUSE PIPE, PASSAIC PRINT WORKS.

some distance around had an unnatural hue. The operations carried on in bleaching, dyeing, and printing calico involve the pollution of large quantities of water, partly by mineral, but chiefly by organic matters. It is said that the most dangerous ones are not turned into the river. But certainly enough refuse is turned in to give the river a very dirty look. Every inch of bank that the river touches is black as tar when the tide is out. Over the surface float bits of refuse of rags and streaks of coloring matter.

"I have seen that race," said Mr. Leake, "all colors, sometimes red, sometimes blue, and at times green."

"I suppose the mill owners know what this boat is after when they see her, don't they?" asked the reporter.

"You bet they do," said the inspector. "They used to shut off their streams of refuse water when they saw us coming up the river, and we have had to go down below, anchor, and come quietly up in a rowboat after dark to collect samples of it."

"How do you know that they don't empty forbidden stuff into the river when they are sure you are away?"

"Perhaps they do. We know, however, that they have appliances for getting rid of it in another way."

A little distance above Passaic the water again loses its inky appearance and the banks resume their natural color. One of the principal tributaries of the Passaic is the Saddle River, which comes out at Garfield. This stream is never a source of pollution to the Passaic unless it be when leakages occur in the oil tanks belonging to the oil storage station near its mouth. The Passaic is not navigable for the little launch of the Board of Pollution above the mouth of Saddle River. The impurities which are thrown into the stream from the busy city of Paterson are at present outside the jurisdiction of the Board, and, of course, Paterson throws out as much stuff as she likes. There are numerous cotton and woollen factories, machine shops, silk and dyeing establishments, which, it is said, every day pour millions of gallons of brilliantly colored and poisonous dyestuffs into the river. There are already twenty-eight miles of sewers emptying by thirteen large outlets, to say nothing of canals and private drainage.

When the launch was spinning along on its homeward trip below Passaic, Inspector Leake, who was at the rudder, suddenly exclaimed: "Hold up, Charley, there's a dog!" Something of a spotted nature was sticking up out of the water and it did look like a dead cur. But when the launch came alongside it proved to be only a bundle of old discarded clothing. Inspector Leake said that about twenty-five drowned human bodies were picked out of the Passaic every year and he had run across some of them himself, but the man who stands on the drawbridge at Belleville, which is a few rods below the Jersey City intake, is the man who makes the most at this business. A bounty of fifty cents is offered by the Board of Pollution for every dead dog or any other animal taken out of the river and buried at least 200 feet away. The drawbridge man has made

MOUTH OF SADDLE RIVER.

as much as $10 in a single month, but he says business is not so good now, as the people are frightened at the surveillance of the Board of Pollution, and are throwing their dead dogs somewhere else. In 1882 the inspector reported that he had caused to be removed from the Passaic and its tributaries during the year "the carcasses of over eighty dogs, three sheep, and one hog."

A second trip up the river made was at high tide. The only difference worth mentioning was noticeable in that section of the river printed black in the above map. This is the section up which the tide carries refuse matter from Newark. Large specks of impurities could be seen drifting along both on the surface and underneath, but were less and less noticeable until near the Newark intake, where the water looked reasonably clear. Just now, after the frequent rains of last summer, the quantity of water in the river is greater than usual, and the tide does not work up so far.

IV.

DOES NEWARK SOMETIMES DRINK SEWAGE?

"Well, admit that she does, what of it? Is it dangerous? The water looks good, tastes good. I've been drinking the water ever since it was introduced and I'm all right."

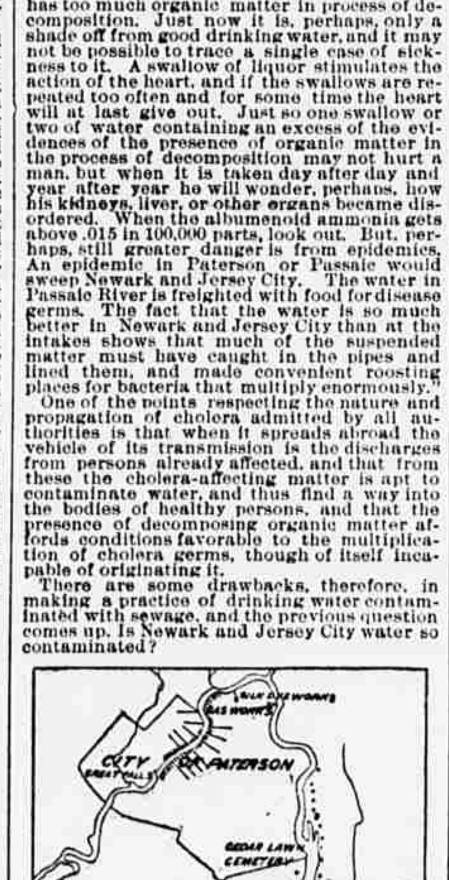
So said an old Newarker the other day. He is one of that class who think that the present supply is good enough, and stands ready to oppose any scheme to spend money for a new supply. If to drink Newark or Jersey City water is to drink sewage, then to drink sewage is certainly not always unpleasant. The water at its worst gushes out of the city faucets reasonably clear. There is undoubtedly an earthy, peaty, or vegetable taste or smell to it at times, but few go so far as to declare that there has ever been a sewage taste to the water drawn from the city faucets. If there was, the hopes of many citizens in Newark for a new water supply would certainly be easier fulfilled. For water to look pure is for it to be pure to very many people. They nestle complacently in the opinion that even if Paterson, Passaic, and Newark sewage is pouring in at the intake, it is all right by the time it is pumped up 167 feet and run 15,000 feet into the city reservoir.

There is a belief prevailing extensively among chemical and medical experts that a water supply should be uncontaminated by sewage; that there is no safety in a middle course; that it is not safe to trust to dilution, storage, agitation, filtration, or anything outside of a long and natural process for a complete removal of disease-producing elements. Prof. Austen of New Brunswick, the present chemist of the Board of Pollution, says that the great danger from drinking Passaic water is not in the possible poison in the sewage that contaminates it, but in the tendency such water has to nourish dangerous germs. In pure water many bacteria, which would be dangerous to introduce alive into the system, would die for want of proper nourishment. A large percentage of organic matter, while not perhaps poisonous in itself, gives dangerous parasites something to feed upon.

"Most of my analyses," said Prof. Austen, "show that water taken from Newark faucets has too much organic matter in process of decomposition. Just now it is, perhaps, only a shade off from good drinking water, and it may not be possible to trace a single case of sickness to it. A swallow of liquor stimulates the action of the heart, and if the swallows are repeated too often and for some time the heart will at last give out. Just so one swallow or two of water containing an excess of the evidences of the presence of organic matter in the process of decomposition may not hurt a man, but when it is taken day after day and year after year he will wonder, perhaps, how his kidneys, liver, or other organs became disordered. When the albumenoid ammonia gets above .015 in 100,000 parts, look out. But, perhaps, still greater danger is from epidemics. An epidemic in Paterson or Passaic would sweep Newark and Jersey City. The water in Passaic River is freighted with food for disease germs. The fact that the water is so much better in Newark and Jersey City than at the intakes shows that much of the suspended matter must have caught in the pipes and lined them, and made convenient roosting places for bacteria that multiply enormously."

One of the points respecting the nature and propagation of cholera admitted by all authorities is that when it spreads abroad the vehicle of its transmission is the discharges from persons already affected, and that from these the cholera-affecting matter is apt to contaminate water, and thus find a way into the bodies of healthy persons, and that the presence of decomposing organic matter affords conditions favorable to the multiplication of cholera germs, though of itself incapable of originating it.

There are some drawbacks, therefore, in making a practice of drinking water contaminated with sewage, and the previous question comes up. Is Newark and Jersey City water so contaminated?



The above map is drawn to indicate the sources of impurities thrown into the Passaic. The large trunk sewers of the cities are shown by the longer lines drawn from the river within the city limits, and the drains by the shorter ones. The mills on the river and its tributaries are shown, and the dots along the back show the residences the drains of which, it is said, have been disconnected from the river. The limit to which the sewage of Newark is backed up and the limit of salt water are indicated, but these vary somewhat, according to the conditions of the stream.

Prof. Albert R. Leeds of the Stevens Institute of Technology at Hoboken began a series of investigations when he became chemist of the Board of Pollution. After a thorough series of analyses and experiments in 1881 he came to these conclusions:

First, that the evil effects of the refuse at Paterson, being largely overcome in the flow of sixteen miles, do not require action so urgently as the impurities introduced lower down. Second, that if the impurities introduced at Passaic were left out, these impurities not having the same opportunity of oxidation and destruction by a long flow, a great improvement would be noted. Third, that it is imperative to keep back the up tide; and the plan to do so by a properly located dam appears to be the best calculated to meet the case.

The same year Mr. Leeds said: "As far as Passaic the influence of the sea is felt, as may be noted by the large increase in the amount of salt held in solution. And even at dead low tide this influence may be seen in the figures representing the composition of mineral matter at the Newark intake, still more at the Jersey City intake at low tide, and most of all at the Jersey City intake at high tide. Then the salt in solution amounted to 32.59 grains per gallon, and about 30,000 gallons in every million pumped up were sea water. At the Newark intake about 8,000 gallons in every million were sea water." This was due largely to the summer drought, very little water going over the Dundee Dam and the sea being backed up further into the river.

Prof. Leeds's investigations the next year led him to state that while samples of water from the Jersey City intake and from the Newark intake both fell below the standard of good drinking water, the samples from the Newark intake were much superior to those taken from the Jersey City intake. He also arrived at the conclusion that of the total pollution out of the Jersey City and the Newark intakes one-third was due to the sewage of Paterson, Passaic, and other points above the intake, and two-thirds to the sewage of Newark and points below. He reckoned that if the organic impurities dissolved in the water at the intakes were reduced one-half the water might be regarded safe. Other conclusions equally strong have been published in the regular reports of the Board of Pollution. Recently Prof. Leeds gave as his opinion that 50 per cent. of the organic matter in the Jersey City water was sewage.

About a year ago, so a scrap of unwritten history says, the body of a horse which was drowned at low tide near the lower part of Newark was found at high tide two days later some distance above the Newark intake. Dr. David L. Wallace of the Health Board of Newark said to a SUN reporter: "No sane man would admit that our water is what it ought to be. It is dangerous. But I don't find that it produces sickness. Our death rate per thousand is only 22.51 a year. I believe that the present supply if run through filters would be better than Croton. In fact, I think the water is as good as Croton to-day."

In his report last year Dr. Wallace called attention to the large number of deaths from phthisis, which he attributed to the nature of some trades and the overcrowding of tenements. There were 473 deaths from this disease out of 3,602 during the year. Of the whole number 1,447 were of children under 5.

One of the last monthly reports of the Hudson County Health Board gives Jersey City's death rate at 22.6 per thousand, and Hoboken, now using Hackensack water, 18.9. From the last weekly report of the New York city Board of Health, published in the *City Record*, the comparative death rates of different cities per 1,000 estimated population is given as follows: New York, 21.95; Brooklyn, 19.69; Baltimore, 18.44; Boston, 23.89; New Orleans, 29.35; Newark, 20.47; Cambridge, 19.55; Fall River, 25.84; Kansas City, 32.63; Richmond, 17.68; Charleston, 28.53; Lawrence, 15.84; Lynn, 13.08; Pittsburgh, 19.25.

The analysis of a gallon of water takes up very little room when printed, but if all the analyses which have been made of Passaic water could be printed in book form, the book would eclipse her Majesty's list of the peerage of the United Kingdom. The average man is too busily engaged in sweating his brow for a little daily bread to meditate much on the official analysis of the water he is drinking for his bone and sinew, and generally an analysis is a meaningless thing to him.

Furthermore, a chemical analysis will not show the actual danger that lurks in a sparkling glass of water. It is quantity not quality of impurity which is thereby detected. And it is the general opinion of authorities that water containing an amount of impurity so small as to escape the tests of the chemists altogether may possess such virulent character as to be unfit for drinking.

"The exact influence or even presence," says an authority on this matter, "of the sewage and trade pollutions which may have passed into a stream cannot be discovered by a chemist when minute in quantity."

In his numerous analyses Prof. Albert R. Leeds adopted as the standard of purity for water supply a sample of water taken at Beatty's dam, located a few miles above the falls at Paterson. "Unquestionably," he says, "a not inconsiderable amount of organic matter has entered the river throughout its 900 square miles of mountain and highland watershed before reaching Beatty's dam, yet no one would question that the Passaic at this point was other than wholesome drinking water." The following are taken from the reports of the Board of Pollution:

	Free ammonia.	*Albuminoid ammonia.*	*Oxygen required to oxidize organic matter.*	*Nitrates.*	*Chlorine.*	*Hardness.*	*Total solids.*
Standard of purity for Passaic water (Leeds)	.005	.015	.32	.35	.35	3.	6.
A Newark faucet, June, 1881	.003	.03	.70	.444	.39	3.29	11.
Newark reservoir, September, 1882	.004	.028	.95	.62	6.05	4.	14.
Newark intake, October, 1882	.0115	.031	1.23	.35	.35	3.9	12.5
Jersey City intake, September, 1882	.021	.013	1.6	.74	43.00	4.4	90.5
Newark intake, average of samples for 1882	.004	.021	....	....	1.30	3.5	10.
Newark intake, average of samples for 1883	.0057	.0377	.309	.325	.893	4.58	8.96
Jersey City intake, average of samples for 1882	.0061	.0261	....	....	7.4	3.7	20.4
Jersey City intake, average of samples for 1883	.0121	.024	.450	.305	1.539	4.6	10.9
Jersey City intake, average of samples for 1884	.0104	.02	.63	.38	.93	3.67	12.1
Newark intake, average of samples for 1884	.0103	.024	.56	.56	1.04	3.89	11.4
Office of Board of Public Works, J. C., average for 1884	.0075	.0203	.48	.51	.53	3.7	10.3
Newark reservoir, South Orange avenue, Dec. 1, 1884	.0011	.003	.50	.20	.90	2.2	....
An analysis of Croton by Prof. Leeds, taken from faucet	.0016	.0157	.47	.4840	2.04	1.92	6.87

Free ammonia is derived in the course of analysis from those nitrogenous organic bodies which have already undergone decomposition. Albuminoid ammonia is derived from those bodies which have not as yet so changed, but will with time and opportunity yield by such decomposition free ammonia. In the upper Passaic the ratio of free to albuminoid ammonia is ordinarily about 1 to 3. When the free ammonia arises much above 1, and especially when it exceeds the albuminoid, something like trade or sewage pollutions must be looked for. The large amount of chlorine in some of the analyses is due to the salt water present at high tide at the intake.

Reasonably pure water contains in solution the maximum amount of oxygen which water can dissolve at natural temperature and under ordinary atmospheric pressure. On coming in contact with decomposing organic matter a portion of this dissolved oxygen is used up in the processes of oxidation. The amount of oxygen held in solution, therefore, becomes an index of how much the water is contaminated by decomposable organic matter. Decomposition out of contact with oxygen is petrifaction, and the products of petrifaction are a host of bodies exceedingly foul and dangerous.

These analyses furnished by the Aqueduct Board themselves show conclusively that Newark and Jersey City have been drinking some very bad water. Other things show that in case of drought or extra defilement they are sure to drink more bad water. The reports also show that even at its best it seldom comes up to the standard of wholesome water. Continually hanging over both cities, like skies full of Damocles's swords, is the frightful peril of a sweeping epidemic, and there is always present the danger of the insidious effects of water carrying too much organic matter. The poison, however trifling, is taken daily, and although when in robust health the individual will not suffer from it, it may be sufficient to make itself felt when he is prostrated by sickness, and his powers of resistance to such influences are then proportionately impaired.

V.

WHAT WILL THEY DO WITH IT?

Here comes the business end of the problem. There is no doubt that the Aqueduct Boards of both cities have done their duty in the matter from the start. They have no right themselves to proceed to build new works, and take a supply of water from the advantageous sources offered in the upper watershed of New Jersey. They have, however, and particularly the Board of Newark, kept the people's eyes open to the dangerous condition of the water, and have informed them, after careful examination, of all the best sources of supply.

The question has really become one of State concern. Gov. Abbett appointed a State Commission to determine the feasibility of the State Government coming to the aid of this closely settled little corner of New Jersey, comprising more than 40 per cent. of the inhabitants of the State, or the people of Newark, Jersey City, Bayonne, Paterson, Hoboken, Elizabeth, Orange, Passaic, Rahway, and East Orange. This Commission, whose report has been without result, found that no revenues accrued to Jersey City and Newark from the ownership of their water works. Any apparent surplus, after paying the water interest, is absorbed by the expenses of operating and maintaining the works, and in the case of Newark a large proportion of these is carried in a general tax levy. The following shows this state of things plainly:

	Water debt.	*Water interest.*	*Water revenue.*
Newark	$3,240,000	$222,800	$236,000
Jersey City	4,838,000	218,070	435,000

The annual cost to pump the present supply of water, with a low estimate for maintenance and depreciation of property, is about $100,000 for Jersey City, and about $60,000 for Newark. The expediency of increasing the annual expenditure, therefore, is a grave question, and it is no wonder that while taxpayers are making wry faces over the water, they make the best of it, and say it is all right and not necessarily hurtful. Of course, there are many who won't drink the water at all. Mr. James W. Miller of Miller Brothers brings all his drinking water from his country seat in wax-lined barrels, and keeps it in tightly sealed glass demijohns. As he wants to use it, he turns it from the demijohns into glass flagons and puts them on ice. Col. Bassett of the Metropolitan Life Insurance Company is about to adopt a similar system. Many people filter the water before using. But the poor people, those who live in the crowded tenements, where phthisis and zymotic diseases flourish, have to take it straight, or, at best, to boil it.

The large taxpayer can easily afford artificial purifiers and then say the water is good.

It will be seen that Jersey City is paying an average of over 6¾ per cent. on her bonds and Newark over 6¾. To build new works, taking the supply from any of the sources in the upper lakes, would take at least $4,000,000 for each city if they went to work independently, and popular opinion is strongly against any partnership arrangement.

Is there any way out of it? This predicament is further complicated by a popular distrust regarding new schemes.

"Let any steps be taken toward new water works," said Judge McCarter of Newark the other day, "and everybody thinks there is a job in it, and the fight gets so hot that every decent man runs for his life, and that is the end of it."

The syndicate brooding over the upper lakes adds another complication. Its office is at 2 Wall street, and it goes by the name of the Bartlett Water Company. Mr. John W. Bartlett recently went before the Newark Aqueduct Board and offered to help Newark out by building works so as to be able in two years' time to supply Newark with water at the rate of $86.50 a million gallons. The Aqueduct Commissioners thanked him, took out their pencils and figured, and found that after using Mr. Bartlett's water for twenty years they would have paid nearly $10,000,000 for it and then would not own anything. They immediately told him that they guessed they wouldn't. And the syndicate, believing that it will have to come some day, goes on brooding over the lakes just the same. The Aqueduct Commissioners believe that the city should own its own works, and is ready to sanction the building when the people are ready for it. An act could be passed giving them the right to condemn the very land the syndicate is holding.

Mr. David Young of the Newark Board of Trade has been figuring on the problem and been trying to arouse popular feeling for a new water supply. In speaking of the debt question he said: "If our present supply is absolutely dangerous to health, and I think it is, our property will depreciate so rapidly that the payment of $3,500,000 of bonds, enough probably for a new supply, will be but a bagatelle in comparison. Our bad water is certainly keeping enterprising people away from Newark even now. A new gravity supply will do away with our cost of pumping, which is $50,924 a year. In the second place, the city has already out $3,485,000 of water bonds, of which sum $3,040,000 is drawing 7 per cent., $100,000, 6 per cent.; $100,000, 5 per cent.; $215,000, 4½ per cent., and $30,000, 4 per cent. Now it will take four or five years to build new works, and $2,490,000 of these bonds now out fall due in 1892. That would be about the time the new works were completed, and every bond could be issued at 3½ per cent."

If this should prove so, Newark could carry $6,000,000 of water bonds for $210,000, or $70,000 a year less than she now pays for carrying $3,485,000 of bonds and for pumping the water.

If new works cost even $4,000,000, and if this sum with the present entire water debt of $3,485,000 could be reissued in bonds at 3½ per cent., Newark would have a water interest of only $261,975 to pay, which is slightly less than she now pays for interest and pumping. This would seem to be a practical idea, and one that would insure Newark a growing future.

BATTLING WITH A SEA MONSTER.

A Finback Whale Kills Three of the Crew of a Whaling Steamer.

From the Boston Globe.

PROVINCETOWN, Nov. 17.—The whaling steamer Lizzie N., Capt. West, which has been engaged in the finback whale fishery on the Eastern coast this season, on Oct. 6, when about fifteen miles east-southeast from Sequin Island, off the coast of Maine, saw a large, lone whale of that species and attempted its capture. A boat was lowered and manned with Capt. West, his mate, and four seamen. Capt. West, with a large heavy whale gun, in which was an explosive bomb lance, took the breach of the boat, while the mate steered. Upon approaching the whale it was seen that he would be an ugly customer to deal with, as he showed no inclination to run, but kept slowly milling around, evidently waiting to be attacked.

When the boat was near enough to warrant a shot, Capt. West fired the gun, but as the sea was rough the motion of the boat destroyed the accuracy of the aim. The whale was badly wounded, but not in any vital part. The whale then made for the boat, and in passing under it struck it with his flukes, throwing it some thirty feet into the air with its crew, throwing the men out. As the boat descended the whale again struck it with his tail and completely demolished the boat, killing one of the crew, Jacob Klock, cutting him completely in two. The whale then commenced to bite and strike with his tail at the pieces of the boat, killing two more men, Neil Olsen and Chris Johnson, who were supporting themselves on pieces of the wreck.

While the whale was engaged in destroying the boat Capt. West, the mate, and one man fortunately secured an oar apiece and swam away from the place. On board the steamer the mishap was seen. Another boat was lowered and the three men picked up and taken on board, much exhausted. Nothing daunted, Capt. West resolved upon capturing the fish. Everything was got in readiness; two guns were loaded, each with the explosive lance, Capt. West taking one and his mate the other, and, taking their positions on the bow of the steamer, word was given to go ahead. The whale in the mean time was lying still among the débris of the wrecked boat, occasionally throwing his flukes into the air.

As the ship neared the monster he left the wrecked boat and made for the steamer with the evident intention of striking her on the port bow. By a quick turn of the rudder the steamer cleared him by a few feet, but with no chance for a shot.

The whale then turned and again made for the steamer, coming down from the windward for about midships of the vessel. Capt. West saw that the whale evidently intended to breach on to the vessel, and word was given to go ahead at full speed. So the whale reared its huge head and body into the air, the little steamer sprung ahead, and the whale fell into the water with a terrific noise, and just cleared the steamer's stern by a few feet. When the whale struck the water it made such a heavy swell that the men were unable to stand on the deck. Seeing that it was impossible to get a shot at the monster without great risk to the steamer and crew, another plan was resorted to. A large, strong water cask, holding about 250 gallons, was emptied of its contents and then bunged tightly. The steamer was once more headed for the fighter, and as she approached him he again came to the attack. The cask was thrown overboard to attract his attention and the vessel retreated to a safe distance. The whale instantly went for the cask, throwing it high in the air with his flukes, but such was its strength and buoyancy no damage was done to it. After several futile attempts to smash the cask with his flukes, he commenced to swim slowly around it, occasionally striking it with his head and trying to bite it, evidently forgetful of the ship which was watching his every movement closely.

This was Capt. West's chance, and silently but swiftly the little steamer glided up behind him at a short distance from his tail, and before he was aware of its approach he received the contents of both of the whale guns, the bomb lances exploding in his lungs. The steamer sheered off to a place of safety, the whale forged ahead about 100 yards and commenced to break and lash the sea into foam in its frenzy and dying struggles, throwing high in air large quantities of blood, showing that he had received his death wound. After about five minutes' struggling he commenced to slowly mill around, and finally, giving one last breach into the air, came down on his side dead.

The steamer then went alongside and fastened to him with harpoons, and with strong ropes and chains secured him to the vessel, by which means he was towed into the harbor, where crowds collected to see the monster and congratulate Capt. West on his skill and daring in capturing the whale, this being the first one ever brought into that place.

The whale is upward of sixty feet in length, and would probably weigh when captured between seventy and eighty tons. It is one of the largest of that species ever captured, and would yield about thirty barrels of oil.

Ingenuity on Both Sides.

From the Boston Gazette.

A gentleman about to close his summer house at Nahant conceived what he considered a brilliant idea to insure the daily personal inspection of every room in his villa during the winter by the old man in whose charge the establishment was to be left. Accordingly, he said to the old man that he should leave all his clocks, one in each room, at Nahant during the winter, and he desired that every one should be wound up at a regular hour each day. The old man concurred in the plan with all his heart, and promised he would not fail. The house was closed. The owner bragged a good deal about his scheme for having every room guarded against leaks, &c., during the winter, and came to Boston. A week or two afterward this gentleman thought he would take a run down to Nahant, and see how things were going. When he arrived there he found his man, who was very glad to see him, and told him that he had wound each clock faithfully as he had directed. On entering the house the two proceeded to the rear drawing room, and the astonishment of the owner may be better imagined than described when he saw ranged along in a row his thirteen clocks, which the old man had brought down to save himself the trouble of going all over the house every day.